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(54) Title: Method for producing aerosol and device for performing said method

[column 1]

Description

The invention relates to a method for producing aerosol for therapeutic treatments and to a device for performing said method.

A device of the aforesaid type is known from DE 33 16 322 A1. In it, a plurality of containers are provided that are secured in a container carrier. Different medications in liquid form are added to these containers. Depending on the therapeutic necessity, very fine mist is produced selectively from the liquid in one or a plurality of containers by means of a nebulizer. The manner in which this occurs is that compressed air from a compressed air source is conducted in a line to the nebulizer, which has a nebulizer nozzle that dips into the liquid via a connecting piece and past which the compressed air is conducted at a relatively high flow speed. The liquid is nebulized in a very fine mist due to the Venturi effect that occurs.

The pressure of the air that is introduced is very sharply reduced by the volume expansion in the container and approaches the ambient atmospheric pressure. The volume of the mist that is produced causes the mist to propagate into a mist collection chamber due to a displacement effect. Connected to the mist collection chamber is an inhalation tube that is provided with a mouthpiece and through which the patient can breath, inhaling the active substance mist.

However, since the mist does not propagate only toward the mist collection chamber, but rather also travels into the interiors of the containers that are not active during the process because for instance the active substance therein cannot be used for that patient, the active substance located therein can be contaminated.

Nor is this disadvantage precluded with another known solution that is disclosed in DE 39 08 909 C2 and that represents a refinement of the device described. In the aforesaid patent specification, there is an attempt to prevent contamination in that because mist chambers are

interposed between container and mist collection channel the mist collection channel is not arranged directly above the openings of the containers. What this attains is that larger mist droplets drip back into the container from which they originate and thus severe contamination of other containers is prevented. However, it is not possible to preclude contamination by finer mist parts because the mist penetrates into the interiors of those containers in which no nebulization is occurring and that are thus not active.

It is therefore the object of the invention to suggest a method for producing an aerosol for therapeutic treatment and a device for performing this method, with which method contamination by non-condensed foreign mist is prevented in the containers that are not active during the performance of the method when using the device.

This object is attained using a method for producing aerosol for therapeutic treatments in accordance with claim 1. It is attained using a device for performing this method in accordance with claim 2.

With the inventive method it is possible to effectively ensure that mutual contamination of the active substances is prevented in the containers, in particular mutual contamination

[column 2]

by non-condensed foreign mist.

In accordance with one particularly favorable embodiment of the inventive device it is provided that arranged between the connector side of the containers and the mist collection channel are closures that can be actuated from the outside and that cover the opening of the containers to the mist collection channel or block from the mist collection channel a mist chamber that is associated with the container and is arranged between it and the mist collection channel.

Naturally it is only possible to ensure certain separation using a hermetically sealed closure to the container. However, since the mist propagates due to the displacement principle, a very effective and inexpensive solution for the object is attained using a cover.

Such a mechanical closure can be attained using a stopper, a valve, or a flap.

In accordance with another embodiment of the inventive device, the interior chamber of a container is joined to a source of compressed air or inert gas via the adjusting device, which is embodied as a throttle valve. In this manner air can flow into the interior of the container and prevent mist from penetrating, thus preventing contamination.

Normally, the normal ambient air is adequate for preventing contamination. However, since air is a mixture of gases from which contamination is also possible in many applications, it is useful to use inert gases to act upon the container interior.

Using the advantageous embodiment in accordance with patent claim 5, according to which a pressure distributor is joined to the compressed air source that provides the pressure actuation, to which are attached, via throttle valves, additional lines that communicate with the interior of the containers, what is attained is that in the interior of the container a pressure is set that is greater than the ambient atmospheric pressure by such a minimal amount that a barely perceivable air flow enters the mist collection channel from the container interior.

It is also advantageous when the additional lines are joined to the interior of the containers via the nebulizers such that the additional lines are integrated into lines that are used for applying pressure to the nebulizers.

Because the additional inflow of air or inert gas into the container interior can be continuous, it is useful to provide this only for the period during which mist is being produced. To this end, it is favorable to arrange an electromagnetic valve, which is connected to an electric timer, between the compressed air source and the pressure distributor.

Because, as is known, devices of the aforesaid type are controlled using a timer, simultaneous control can be attained by connecting the electromagnetic valve to this timer.

In accordance with patent claim 8, there is the option of arranging in the additional lines electromagnetic valves that are connected to an electric timer. This can enable simultaneous control, as well. In addition, each additional line can be individually electrically controlled with this.

The further favorable embodiment of the inventive

[column 3]

device provides that the adjusting device is part of a control circuit that has a first pressure sensor, as a setpoint generator, arranged in the mist collection channel, in an inhalation line connected to the mist collection channel, or on the exterior of the device, and that has a second pressure sensor as a measuring device for measuring the controlled variable that is arranged in the interior of the container or in the mist chamber.

This embodiment offers the advantage that an optimum pressure is always produced in the additional lines and failures are prevented.

The invention is explained in greater detail in the following using an exemplary embodiment. The associated drawing depicts a schematic section through a device.

In it are provided five containers 1 that contain different active substances 2. Nebulizers 3 that are connected to a pressure distributor 5 via lines 4 dip into these active substances 2. This pressure distributor 5, together with the compressor 6, represents a compressed air source, the air being purified by a filter 7.

For controlling the individual nebulizers 3, electromagnetic valves 8 that can be controlled via push-button switches 9 are arranged in the course of the lines 4.

Thus mist production in the containers 1 can be selectively turned on using simple actuation of the push-button switches 9.

The mist produced travels through mist chambers 10 into a mist collection channel 11 and from there out to the patient via an inhalation line 13.

The mist chambers 10 are disposed in a container carrier 14 to which the top openings of the containers 1 are attached.

A pressure distributor 16 is attached to the pressure distributor 5 via an electromagnetic valve 15. Five additional lines 17 go out from the pressure distributor 16 and are each integrated into a line 4 via throttle valves 18.

A pressure is set on the throttle valves 18 that is so minimal that it does not cause any mist to be produced in the nebulizers 3, but that is enough to produce a weak air flow in the containers 1 and the mist chambers 10. This air flow is then adequate for preventing mist from penetrating into other containers 1 when the respective container 1 is not active at that time, that is, the nebulizer is not supplied with compressed air via the line 4. Thus it is possible to effectively prevent mutual contamination of the active substances 2.

An electric timer 19 is provided for controlling the device and its output controls the electromagnetic valve 15. In this manner it is possible for compressed air in the pressure distributor 16 to be provided from the compressed air distributor 5 only when the device is being used.

Legend

1 Container

2 Active substance

3 Nebulizer

4 Line

5 Pressure distributor

6 Compressor

[column 4]

7 Filter

8 Electromagnetic valve

9 Push-button switch

10 Mist chamber

11 Mist collection channel

12 Rebreathing valve

13 Inhalation line

14 Container carrier

15 Electromagnetic valve

16 Pressure distributor

17 Additional line

18 Throttle valve

19 Electric timer

Patent claims

1. Method for producing aerosol for therapeutic treatments in which very fine mist is produced selectively in one or in a plurality of containers (1) from treatment liquids (2) disposed in containers (1) by nebulizers (3) that are arranged in each of said containers (1) and that are driven by a gaseous medium, which mist travels from the respective container (1) through a common mist collection channel (11) into an inhalation device (13), and a gaseous medium simultaneously being introduced into non-active containers (1) by means of said nebulizers (3) at such a pressure that no mist is produced in said non-active containers (1) but that is enough to prevent mist from flowing in from active containers (1).
2. Device for performing the method in accordance with claim 1, comprising:

a plurality of containers (1), each for one treatment liquid (2) and each of which cooperates with a nebulizer (3) that is driven by a gaseous medium and that can be adjusted using an adjusting device, and each of which is connected to a common mist collection channel (11); means for preventing condensate contamination that are arranged between said containers (1) and said mist collection channel (11);

an additional adjusting device that is embodied and arranged such that in non-active containers (1) a gas flow exits from said nebulizers (3) at such a pressure that no mist is produced in said non-active containers (1) but mist from other, active containers (1) is prevented from flowing in.

3. Device for producing aerosol for therapeutic treatments in accordance with claim 2, characterized in that arranged between the connector side of said containers (1) and said mist collection channel (11) are closures that can be actuated from the outside and that cover the opening of said containers (1) to said mist collection channel (11) or block from said mist collection channel (11) a mist chamber (10) that is associated with the container (1) and is arranged between it and said mist collection channel (11).
4. Device for producing aerosol for therapeutic treatments in accordance with claims 2 or 3, characterized in that the interior of a container (1) is joined to a source of compressed air or inert gas via the adjusting device, which is embodied as a throttle valve (18).
5. Device for producing aerosol for therapeutic

[column 5]

treatments in accordance with any of claims 2 through 4, characterized in that a pressure distributor (16) is joined to the compressed air source (5, 6) that provides the pressure actuation, to which are attached, via said throttle valves (18), additional lines (17) that communicate with the interior of said containers (1).

6. Device for producing aerosol for therapeutic treatments in accordance with claim 5, characterized in that said additional lines (17) are joined to the interior of said containers (1) via said nebulizers (3) such that said additional lines (17) are integrated into lines (4) that are used for applying pressure to said nebulizers (3).
7. Device for producing aerosol for therapeutic treatments in accordance with claim 5 or 6, characterized in that an electromagnetic valve (15), which is connected to an electric timer (19), is arranged between said compressed air source (5, 6) and said pressure distributor (16).
8. Device for producing aerosol for therapeutic treatments in accordance with claim 5 or 6, characterized in that arranged in said additional lines (17) are electromagnetic valves that are connected to an electric timer (19).
9. Device for producing aerosol for therapeutic treatments in accordance with any of claims 2 through 8, characterized in that the adjusting device is part of a control circuit that has a first pressure sensor, as a setpoint generator, arranged in said mist collection channel (11), in an inhalation line (13) connected to said mist collection channel, or on the exterior of the device, and that has a second pressure sensor as a measuring device for measuring the controlled variable that is arranged in the interior of said container (1) or in said mist chamber (10).

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